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HOSPITAL DESIGN NOTE

PROTECTION AGAINST FIRE

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I. Scope

1. This Note provides guidance on the protection of hospitals against fire. It describes design and constructional requirements which should be met if new buildings are to be adequately protected from the effects of fire. There are already in existence regulations for Scotland, termed the Building Standards (Scotland) Regulations, 1963, and there will shortly be available Building Regulations for England and Wales which will cover institutional buildings including hospitals. These regulations are necessarily of a general nature and can normally be regarded as a minimum requirement. This Note is intended to make more detailed recommendations taking into account the special circumstances appertaining to hospitals. Means of escape from fire is the responsibility of the fire authority, but this Note also makes recommendations on this aspect. The standards put forward have been prepared in consultation with representatives of the fire authorities and it is likely that they will prove acceptable to local fire authorities. It does not deal with fire-fighting equipment and fire warning systems; these will be covered by a Technical Memorandum on Hospital Fire Precautions to be published shortly, which should be read in conjunction with this Note. Nor does the Note cover residential staff accommodation since adequate recommendations on these will be made in a British Standard Code of Practice on precautions against fire in flats and maisonettes, due to be published in the near future. It is assumed that hospital authorities will always consult with the local fire authority during the early planning stages of building schemes.

II. Introduction

2. It is necessary to design and construct buildings both to minimise the spread of fire and to facilitate the movement of people to places of safety. The difficulty in moving patients, even horizontally, increases the importance of ensuring that full consideration is given during the planning of buildings to the measures to be undertaken for fire protection. Protection against fire is of the highest importance, and should be considered at the early stages of design, as are other planning requirements such as noise control. However, where there is conflict of requirements, safety of lives must be given priority.

3. In designing for fire protection two main principles must be observed:

(*a*) adequate means of escape must be provided from all parts of the building;

(b) the building should be so designed and constructed as to minimise the risk of smoke and fire spreading.

4. The basic means of providing fire protection is to divide the building into fire resisting compartments, thus enabling fire outbreaks to be isolated within the compartment of origin. The whole of any hospital building, both rooms and communication areas, must therefore be planned in fire-tight compartments.

5. The division of the hospital into fire-tight compartments enables evacuation of staff and patients to be phased. The first phase would be the movement of patients and staff from the compartment in which the fire originated into an adjacent compartment, the fire then being sealed off in the evacuated area. Only if the fire outbreak cannot be brought under control within the compartment in which it originated need the second stage of escape by way of staircases to another compartment be necessary. The third phase is the evacuation of the building, and moving people outside. Should stages 2 and 3 become necessary, the gain in time due to the existence of compartments will reduce the urgency with which these more difficult stages need be undertaken. If the fire brigade is promptly called, and the compartment in which the fire originated is quickly evacuated and closed, the second phase of evacuation may not be necessary. In planning, emphasis must be laid on ensuring that the first stage evacuation can be carried out effectively and safely. This requires consideration of the nature of fire risk in hospitals.

6. The risk to human life is greatest in those parts of the hospital where patients are treated—in particular, wards, where many patients will be incapable, in the event of fire, of moving to a place of safety without assistance.

7. Wards, whilst being a high life-risk area, are not particularly susceptible to fire outbreaks, and as they are staffed day and night, such outbreaks as occur are normally quickly detected and can be dealt with by means of first aid appliances (see the forthcoming Technical Memorandum on Fire Precautions). The risk of fire is much higher in other parts of the hospital such as laboratories and pharmacies, main stores or main kitchens, because of the nature of the work carried out there, and in those parts where there is a heavy fire-load, e.g., where large amounts of combustible materials are stored. Among the high fire-risk and high fire-load areas are the following:

(i) Main laboratories and pharmacies;
(ii) Main kitchens;
(iii) Laundries;
(iv) Boiler houses;
(v) Works departments;
(vi) Main stores.

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8. Operating theatres constitute a high explosive-risk rather than a high fire-risk and reference should be made to the Report of the Working Party on Anaesthetic Explosions published in 1956 and to the advice on anti-static precautions given in Technical Memoranda Nos. 1 and 2. Where radiological apparatus is employed in operating theatres appropriate anaesthesia should be used.

9. In addition, there is a risk of fire in x-ray film processing units which have to be left switched on at night when the department is unattended.

10. The transmission of fire from high fire-risk areas, assuming the fire resistance of the structural separation is adequate, is by means of the communication routes, such as staircases, lift shafts, and ducts for engineering services. Precautions must therefore be taken to prevent the spread of fire and smoke through these spaces. Specific guidance on this is given later in the Note.

11. The requirements of good fire protection can be considered from two aspects; first, the need to plan the size and disposition of compartments to ensure adequate control of fire spread and to provide satisfactory means of escape; second, the need to decide what type of construction and materials will be necessary for this. Part IV of the Note considers fire protection from the former aspect, Part V from the latter.

III. The formation of compartments and sub-compartments

12. The Building Regulations for England and Wales are expected to require that compartments* be limited to one storey in height and 20,000 sq. ft. in floor area. It should be noted that Building Regulations in Scotland do not necessarily confine a compartment to one storey (see Regulation 24), but in the interests of safety and to facilitate the first stage of escape it is recommended that compartments should be so confined. Scottish Building Regulation 24 also limits the floor area of a compartment to 15,000 sq. ft.

13. In the recommendations that follow on compartment size it will be found that, because of the nature of risk in hospitals, these call for the building to be divided into smaller cells than those defined above. The smaller cells or sub-compartments* are considered to function in a similar manner to compartments, except that doors which communicate between them are not required to provide the full standard of fire resistance which will be called for by the Building Regulations. Fire-resistance standards are given in Part V. Every sub-compartment within the hospital exceeding 2,000 sq. ft. in area should normally have at least two exits, either into other sub-compartments, compartments or to a means of vertical escape, or one of each. Compartments and sub-compartments are dealt with below under four main headings:

A—in areas of high fire-risk or high fire-load;
B—in areas of high life-risk;
C—in remaining parts of the hospital;
D—in communication areas.

A. Formation of compartments and sub-compartments in areas of high fire-risk or high fire-load

14. Areas of high fire-risk should form separate compartments from all others.

Main stores

15. Main stores on or above ground level may require to be divided into more than one sub-compartment, should the cubic capacity of the whole exceed 50,000 cubic feet. It is preferable that all storage areas should be sited adjacent to external walls, or be capable of being ventilated. Ventilation and siting adjacent to an external wall is essential for any store over 1,000 sq. ft. in area. If main stores are in the basement the size of the sub-compartment should not exceed 20,000 cubic feet. Ventilation of accommodation below ground level is particularly important as smoke from a fire can hinder escape and make fire fighting difficult. Smoke outlets for fire brigade use may be required, and some means of permanent or openable ventilation direct to the open air should be provided. Access to basements is dealt with in paragraph 33.

16. Main stores for flammable liquids should be in a separate building or buildings wherever site conditions permit, and the amount of flammable liquid kept within other buildings should be limited to that required for current use. The walls, roof and floor of the store should be constructed of non-combustible materials of adequate fire resistance (see paragraph 47). The entrance should have a raised sill of sufficient height to retain on the floor the whole of the liquids in the store plus an additional 10 per cent over the volume of fluids to be contained; permanent ventilation should be provided to the outside air. Where the store has to be incorporated in the main hospital building, it should form a separate compartment with entrance and exit leading direct into the open air or via a protected corridor.

Boiler houses

17. The boiler house should, where possible, be in a separate building. If it is part of any other building it should be a separate compartment. It is desirable that access to the boiler room and fuel stores should be from outside the building only, and away from other exits from the main building. Where internal communication with a boiler room or fuel store is required, it should be by way of a ventilated lobby which does not also communicate directly with any high risk area

*See definition in Glossary.

or a place which would jeopardise means of escape from the main building. The boiler room should be provided with permanent ventilation. In the areas of some local authorities, byelaws are in force for securing that oil-burning equipment including fuel storage tanks, are installed with proper regard to preventing danger from fire, and although these byelaws do not apply to Crown premises it is desirable that hospitals should comply with them. Recommendations for fire precautions in oil-fired heating installations are contained in British Standard Code of Practice, CP.3002, Oil Firing. Gas-fired installations should be installed in accordance with the recommendations of CP.332. 303: 1951, Installation of Gas-Fired Boilers for Central Heating by Hot Water. In the design of the boiler room, the possibility of a future change to other fuels should be considered at the design stage of the building.

Paint spraying shops

18. If provided, these will normally be sited within the works department. They constitute a particularly high fire-risk and should form a separate compartment. Those shops which are likely to be used for cellulose spraying should comply with the Cellulose Solutions Regulations, 1934 made under the Factory and Workshops Act, 1901. More detailed guidance can be found in the "Recommendations in connection with spraying and other painting processes including the use of inflammable liquids" published by the Fire Offices Committee.

Other high fire-risk areas

19. Main kitchens, laundries and stores within the works department should each form separate compartments, but it will not normally be necessary for them to be internally sub-divided for fire protection purposes. Laboratories and pharmacies should also form separate compartments and these may need to be sub-divided; guidance is given in Fire Prevention Note No. 2/62—Fire Prevention in Laboratories—issued jointly by the Home Office (Fire Service Department) and the Scottish Home Department.

B. Formation of compartments and sub-compartments in areas of high life-risk

20. Areas of high life-risk, e.g. wards, must form separate compartments from all other parts of the building. Wards should be planned so that all staff and patients within a ward compartment or sub-compartment should be able to move horizontally to another compartment or sub-compartment; in some instances this may mean dividing a ward nursing unit into more than one sub-compartment. The compartment or sub-compartment into which ward patients are evacuated should not be a high fire-risk area, and must be of an adequate size to receive all the patients who may be removed there in an emergency. It is further recommended that no point within a ward compartment or sub-compartment should be more than 100 ft. (along the line of travel) from an exit to another compartment or sub-compartment. It is preferable that these standards be met even when wards are located on the ground floor* of a building. In order to ensure a sufficiently quick evacuation of patients in the event of fire, it is recommended that no ward sub-compartment should contain more than 40 beds.

21. However, whilst movement of patients horizontally to another compartment or sub-compartment will in most cases be the only evacuation necessary in the event of fire, the need for vertical evacuation to a point (perhaps outside the building) still remains a possibility which must be planned for. Therefore no point on a ward floor should be more than 100 ft. along the line of travel from an exit to a staircase. (See paragraph 25-33 on escape staircases.) If alternative escape routes from any point in a compartment or sub-compartment cover common ground for any part of the way, that distance which coincides should not exceed 50 ft. in length.

C. The formation of compartments in the remaining parts of the hospital

22. The formation of compartments in other parts of the hospital, excluding communication areas, will not require the sub-division of any storey unless the area of that storey exceeds approximately 20,000 sq. ft.§

D. Formation of compartments for communication areas

Staircases

23. In the event of fire it is essential to keep stairways passable, both to facilitate fire brigade access and, in severe outbreaks, to provide a vertical means of escape for patients and staff. Lifts cannot be relied on as a means of evacuation in the case of fire. Staircases must therefore form separate compartments in order to prevent fire and smoke from entering them.

24. More elaborate precautions are suggested for fire brigade staircases because if the fire brigade have clear access via staircases, vertical evacuation will very rarely be necessary. A distinction is, therefore, made between escape staircases and staircases used by the fire brigade in discussing the precautions to be taken against the entry of fire and smoke.

Escape staircases

25. Generally at least two staircases should be provided on each floor. A single staircase may be acceptable where the uppermost floor is not more than 20 ft. above the ground, and the area is less than 2,000 sq. ft.†

26. An additional factor to be taken into account in the number of staircases required is that the length of "dead end" beyond the terminal staircases in any block should not exceed approximately 50 ft.‡ measured along the line of travel from any point in the "dead end" The incidence of "dead ends" will vary according to

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*See definition in Glossary.

§15,000 sq. ft. in Scotland (Scottish Regulation No. 24).

†Table II of the Scottish Regulation, page 155, require at least two staircases in all cases.

‡Regulations in Scotland restrict this to 40 ft.

the layout and dimensions of particular floors, but they should be avoided wherever possible. In elongated plans it will generally be advisable to site stairs towards the extreme ends of the block. In double-corridor layouts and all core blocks, escape staircases may be embodied in the core but there should always be direct entrance to them from the corridor between the core and the perimeter accommodation.

27. Where openable windows cannot be provided to the staircase, each staircase should incorporate a permanent vent at the top. Additionally, in buildings with floors higher than 60 ft.* above ground level, means should be provided at suitable intervals in the vertical height of the staircase for releasing or removing smoke. If mechanical ventilation is provided and staircases are pressurised and it is not possible to provide permanent smoke releases, the position then is quite different and at the present time it is felt that there is insufficient technical information available to make recommendations on this point.

28. All staircases and parts of the building liable to be used in time of emergency for the evacuation of patients should be designed to permit the unhampered passage of stretcher-borne patients. It is important to allow adequate space for turning, particularly on landings.

29. In buildings of 60 ft. and over to the uppermost floor, escape staircases should be entered through lobbies at each level, and the ventilation, in whole or part, may need to be by mechanical means.

30. At ground level, staircase enclosures should either discharge directly into the open air, or into a separate compartment or protected corridor leading to the open air. The separate compartment or protected corridor may connect with other parts of the ground floor only by way of a communication area‡.

31. Staircases which serve ward floors should not, generally, also serve any part of the building used for main stores, laboratories, kitchens or other departments of high fire-risk unless such risks are contained in compartments which are effectively separated from the staircases. (See also paragraph 21 on previous page.)

32. Laboratories, when located on the topmost floors of the building, will not constitute a risk to ward floors below, but where such departments occupy more than one of the highest levels, due consideration will need to be given to the arrangement and protection of the escape routes from each.

33. Because of the difficulties associated with fire fighting and escape in basements,** staircase access to them must be carefully planned. It is preferable that all stairs to the basement should be entered from the open air only, and at ground level, and in such positions that smoke from any fire in the basement will not obstruct any exit serving the ground or upper floors of the building. Where a staircase is the only means of access within a compartment, the staircase should not continue directly to the basement. However, in buildings with two or more staircases available for escape from any section of the building, one of the staircases may be taken to the basement, provided the stairs are fully enclosed and protected by lobbies at ground and basement level to check fire spread. Additional access staircases to basement areas may be required for fire fighting. Alternative access for escape or fire-fighting purposes should always be provided for every storey below ground level which exceeds 2,500 sq. ft. in area.

Staircase for fire brigade use

34. The number and disposition of staircases for fire brigade use should normally be such that no point on the floor is more than 200 ft. from the entrance to such a staircase, measured along the line of travel. Fire brigade staircases are not normally necessary for buildings less than 60 ft. high. Fire brigade staircases may be numbered amongst those providing a means of escape but additional escape staircases will be necessary to satisfy the travel distance mentioned in paragraph 21 above. Provision should be made for fire-fighting mains in the staircase enclosure or lobby (see paragraph 81).

35. The following measures are recommended for fire brigade staircases:

(i) Staircases should have openable windows on all levels.

(ii) Lobbies to staircases are required on each floor, should not be less than 60 sq. ft. in area, should have permanent openings in an external wall of not less than ½ sq. ft. and should have windows with openable areas amounting to not less than a quarter the floor area of the lobby or 15 sq. ft. whichever is the greater.†

(iii) Occasionally it may not be possible to meet (i) and the ventilation requirements of (ii) because it is impracticable to place staircases on external walls. Where this is so, staircases should be approached by lobbies at all levels, and ventilation in both lobbies and staircases should be provided either naturally or mechanically.†

(iv) The inlet connections to a dry rising fire main in a building should be within 60 ft. of a suitable access point for fire brigade appliances. The inlet or a clear directional sign should be within sight of the access point.

36. Where lobbies and staircases are mechanically ventilated, the ventilation plant should be served by two electricity supplies, accommodated in separate compartments, and the arrangements should be such as to ensure that failure of the supply which is connected will cause an automatic change-over to the other supply.

*Height (see Glossary).

‡See Regulation 50(5) for Scotland.

**See Glossary.

†See Regulation 51 for Scotland.

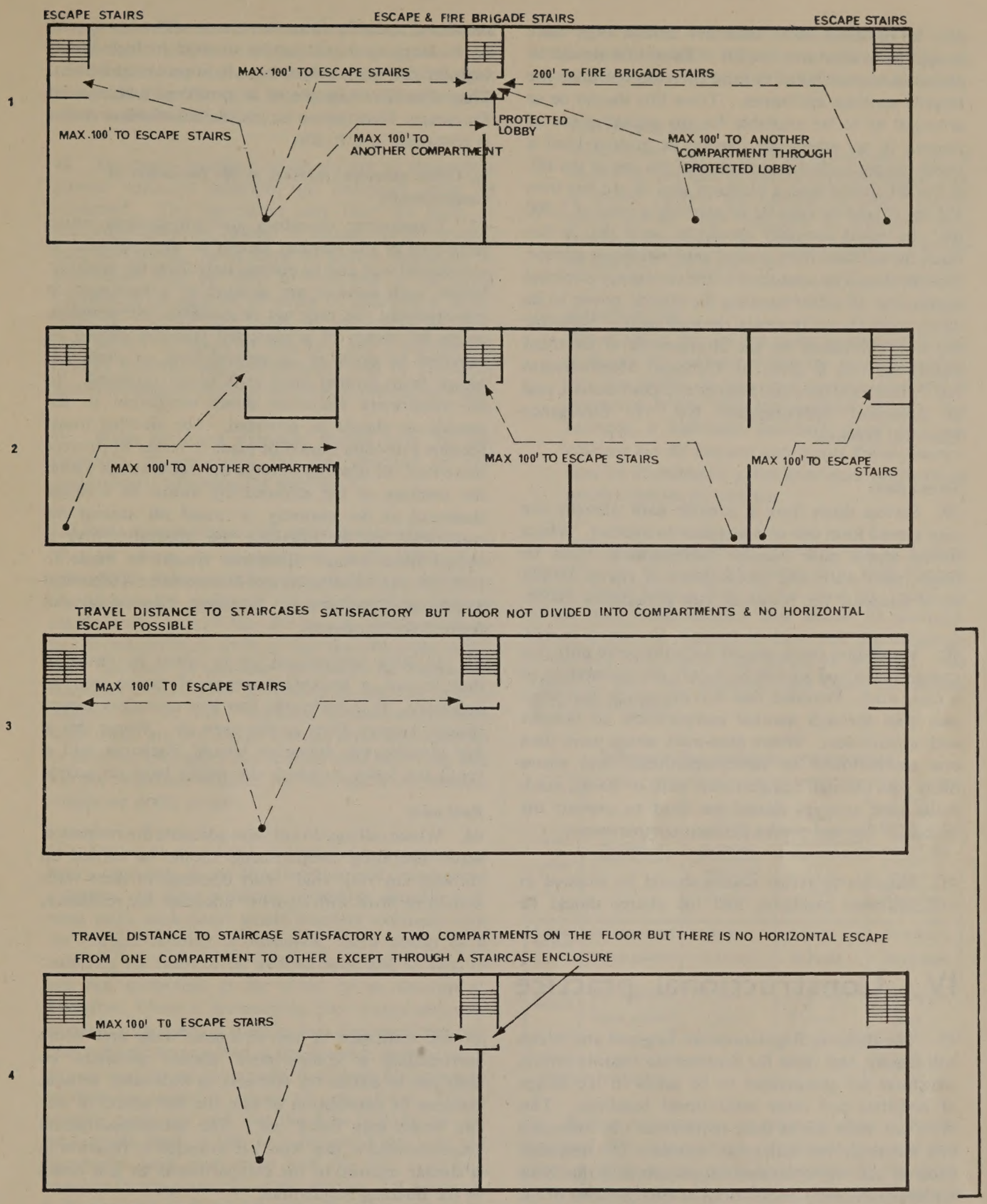


FIGURE 1 DIAGRAMS TO ILLUSTRATE 'COMPARTMENTING AND ESCAPE' REQUIREMENTS

Lifts and lift shafts

37. Lifts should, where possible, be grouped in such a way that the lift system forms (if need be within a staircase enclosure) a separate fire-resistant enclosure, and protected at each floor level with fire-check doors to all openings (see paragraph 57). Lifts within protective enclosures should be provided with permanent vents at the top not less than 1 sq. ft. in area for each lift.* Lift motor rooms should normally be sited at the top of the shaft. Where this cannot be arranged the motor room should be separated from the shaft, forming a separate compartment, containing only the minimum size openings for the passage of cables, etc. Lift motor rooms should be provided with permanent ventilation direct to the open air.

*See Regulations 32 and 124 for Scotland.

38. In buildings more than five storeys high there should be at least one fire lift. These lifts should be placed closely adjacent to (and preferably within) fire brigade staircase enclosures. These lifts should be so arranged as to be available for the exclusive use of firemen in an emergency, having at ground level a switch giving exclusive control over the use of the lift. A fire lift should have a platform area of not less than 15½ sq. ft. and be capable of carrying a load of 1,200 lbs. Its speed normally should be such that it can reach the top floor from ground level within one minute. This lift should be connected to the emergency electrical supply and all cables carrying the electric power to its motor room should be routed through areas of negligible fire risk. Guidance on the arrangement of electrical supply for lifts is given in Technical Memorandum No. 7, Electrical Services: Supply and Distribution, and in Technical Memorandum No. 11, Emergency Electrical Services.

Service ducts

39. Service ducts form a possible path whereby fire may spread from one compartment to another. Where service ducts pass through compartment walls or floors, their walls and access doors or covers should be of adequate fire resistance (see paragraphs 58-59).

40. Ventilation ducts should normally serve only one compartment and should have only one connection to a main duct. Provided that it is protected, duct-work may pass through another compartment to connect with a main duct. Where duct-work serves more than one compartment or sub-compartment, and where ducts pass through compartment walls or floors, automatic steel shutters should be fitted to prevent the spread of fire and smoke between compartments.

41. Hoppers to refuse chutes should be situated in well-ventilated positions, and the chutes should be continued upwards with a ventilation outlet above roof level. Hoppers should not be situated in high life-or high fire-risk areas unless they are in protected lobbies. They should not be placed in protected lobbies used for escape. Information on installation of refuse chutes is contained in C.P. 306.

E. Other measures relating to the formation of compartments

42. Transformer chambers and sub-stations which form part of the building should be sited adjacent to an external wall and be entered only from the open air. Where such services are situated in a basement or sub-basement this may not be possible. Nevertheless, access by means of a protected staircase should be provided to open air at ground level so sited that escape from ground floor exits is not impaired. In all transformer chambers direct ventilation to the outside air should be provided. For oil-filled transformers provision should be made to retain 10 per cent more than the quantity of oil in the transformers within the confines of the chamber by means of a raised threshold at the doorway, a raised sill around the equipment, or by installing the apparatus over a ballast filled sump. Reference should be made to C.P. 321. 102, Installation and Maintenance of Electrical Machines, Transformers, Rectifiers, Capacitors and Associated Equipment.

43. In large sub-stations, or in others by virtue of their layout, a secondary means of escape may be necessary. It is preferable that this secondary means should connect direct to the open air. Where this is not possible the doorways should discharge into a ventilated lobby to which the public have no access.

Roof voids

44. Where ceilings do not have adequate fire resistance, walls separating compartments should be carried up through any roof void. Any openings in these walls should be fitted with doors of adequate fire resistance.

IV Constructional practice

45. The Building Regulations for England and Wales will require, and those for Scotland do require, certain structural fire precautions to be taken in the design of hospitals and other institutional buildings. This Note has made use of these requirements to formulate and elaborate the standards necessary for hospitals. Most of the recommendations contained in this Note are straightforward elaborations or enlargements of the Building Regulations.

A. Multi-storey buildings

(1) Structural elements and compartment walls

46. Paragraphs 5 and 13 of this Note, on the formation of compartments, draws attention to the need, for reasons of safety, to divide hospitals into small sub-compartments. These are in many cases much smaller than the maximum sizes set down by the Building Regulations. In the latter it is assumed that the grades of fire resistance of the structure, walls and floors surrounding a compartment should generally be sufficient to enable the elements to withstand, without collapse or penetration of fire, the full effects of any fire which may break out. The sub-compartments recommended in this Note are intended to function in a similar manner to the compartments as laid down in the Building Regulations.

47. Structural elements—e.g. load-bearing walls, floors and structural frames—together with walls separating compartments or sub-compartments, should have a fire resistance of at least 1 hour for buildings up to 90 ft.* in height and 1½ hours for buildings over 90 ft.* high. Structural elements in all areas below ground level should have 1½ hours' and 2 hours' fire resistance

*Schedule 8, Table 7, of the Scottish Regulations fix the height as 80 ft.

respectively. The structural elements themselves should be non-combustible, but exception may be made for sub-compartment walls and single-storey buildings (see paragraph 69). The table in paragraph 53 summarises these requirements.

48. Structural members which do not in themselves possess sufficient inherent fire resistance must be protected. The protection may take the form of protective coverings, casings or membranes to columns, walls and floors. Some forms of hollow protection or membranes may be liable to weakness at the joints because of the method of fixing or inadequate workmanship. Where such forms of protection are used, care should be taken to eliminate any continuity of cavities between adjacent elements and to introduce non-combustible fire stops within wall and ceiling voids.

49. Walls enclosing staircases should have the fire resistance recommended for the structure of the compartment adjoining the staircase.*

(2) Doors in compartment walls and staircase enclosures

50. All doors in compartment walls other than openings in staircase enclosures or lobbies to staircases should have fire resistance not less than that required for the walls in which they are placed. Similarly doors in sub-compartment walls in high fire-risk areas, other than openings in staircase enclosures or lobbies to staircases should have fire resistance not less than is required for the wall. Openings in sub-compartment walls which are not in high fire-risk areas and openings in staircase enclosures and lobbies need have only half the fire resistance required for the wall or 30 minutes, whichever is the greater.

51. Doors of one hour fire-resistance or more are heavy, open only in one direction and must close against a rebate. In some positions, notably in sub-compartment walls, such doors would interfere too much with the normal running of hospitals; there would be a tendency for them to be wedged open and so lead to less fire protection in the event of an emergency. Therefore, where a fire-resisting door would seriously interfere with hospital routine, it is suggested that two doors should be provided in the opening, one for every day use and the other normally fixed open but arranged to close by automatic means in case of fire. If the hospital needs are such that the door in daily use can be a single door, it will be sufficient if this and the automatic door each have half the fire resistance required for the protection of the opening. If, however, it is necessary to have a double-swing door for daily use, this may be a fire-check door (see paragraph 52) but the automatic door should have the full fire-resistance required for the protection of the opening. The latter may be a roller shutter door of the appropriate fire-resistance.

52. There are two accepted types of fire-resisting doors; these are termed "fire-resisting doors" and "fire-check doors". The former gives full fire resistance, whilst the latter is fire-resisting but not to such a high standard. These may be defined as follows:

Fire-resisting door

When either side of the door is exposed to fire it should not collapse within the period specified, and it should prevent the passage of flame for the same period. For example a one-hour fire-resisting door does not collapse or allow passage of flame for one hour.

Fire-check door

When either side of the door is exposed to fire it should not collapse within the period specified, but the length of time that passage of flame is prevented is less than the specified period. For example, a half-hour fire-check door does not collapse for 30 minutes and resists flame penetration for 20 minutes; a one-hour door resists flame penetration for 45 minutes.

53. Where openings in the dividing wall of a compartment (or of a sub-compartment in high fire-risk areas) should have a door of the same fire resistance as the wall, a fire-resisting door should be provided. Where a door is required to have half the resistance of the wall a fire-check door should be provided. See Figure 2, also the following table which summarises these requirements.

Minimum fire resistance requirements

Building height	*Position of compartment*	*Walls and floors between compartments, sub-compartments and structural frames*	*Doors in openings of walls between compartments. Fire-resisting door*	*Doors in openings between sub-compartments* and in staircase enclosures and lobbies. Fire-check door*
Under 90 ft.†	Above ground	1 hour	1 hour	30 minutes
	Below ground	1½ hours	1½ hours	30 minutes
Over 90 ft.†	Above ground	1½ hours	1½ hours	30 minutes
	Below ground	2 hours	2 hours	1 hour

*Except in high fire-risk areas.
†80 ft. in Scotland.

54. Further information on doors is given in British Standard 459, Paras. 1 to 4. It should be noted that where a single-vision panel is required in fire-check doors the panel should be of wire glass not greater in area than 4 sq. ft. Glazed lights should be of fire-resisting glazing; methods of fixing glazing are given in B.S. Code of Practice C.P. 152:1960, Glazing and Fixing of Glass for Buildings.

55. Whilst single-leaf doors are preferable from the fire protection aspect for linking sub-compartments or at entrances to staircase enclosures, in many instances in hospitals double doors will be necessary to permit movement of non-ambulant patients. Doors should

*See also Scottish Building Regulations.

open in the direction of escape; if placed across corridors in such a position that they give access to staircases in either direction, double doors may be double swing close fitting butt-jointed stiles. In high fire-risk areas where fire-resisting doors are required, single-leaf doors opening one way only must be provided. Doors should have self-closing devices; in those parts of the hospital where the movement of traffic is such that it is likely that the doors will be fastened in an open position for a large part of the day, some permanent means for allowing this should be provided of a type which can be instantly released in case of need. Doors in staircase enclosures however should never be fastened in the open position and no provision should be made to allow for this. At night, doors between compartments should never be fastened in the open position and notices should be displayed to this effect and staff instructed in the use of the doors.

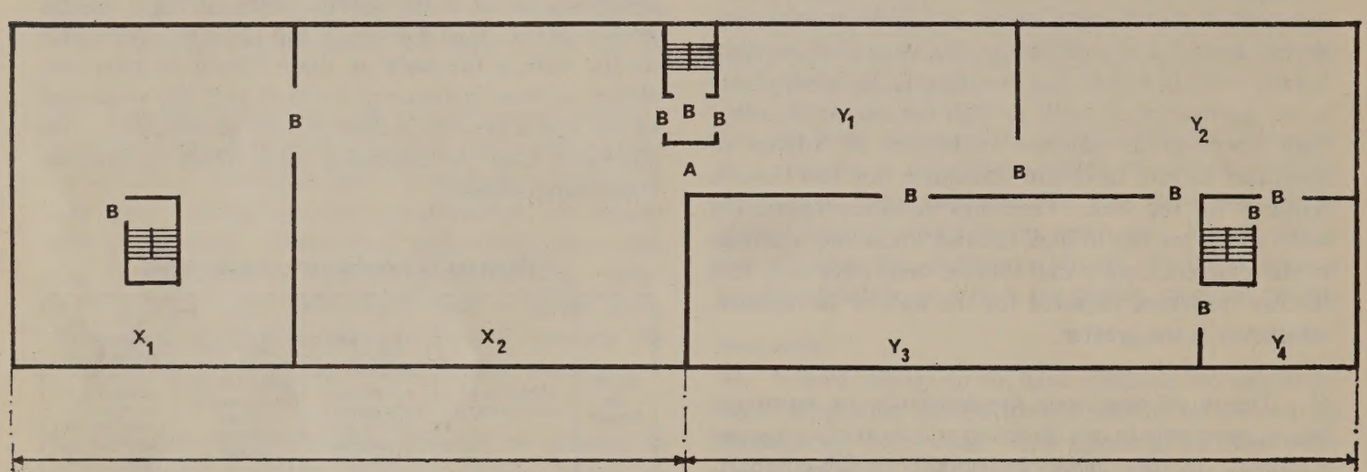
56. Further guidance can be found in British Standard Code of Practice, C.P. 151: Part I 1957, Doors and windows including frames and linings. Part I. Wooden doors.

(3) Lift shafts and lifts

57. Walls enclosing lift shafts which are not enclosed within a staircase should have a fire resistance of 1 to 1½ hours, depending on the height of the building. The doors of all lifts and their surrounding frames should have a half-hour fire resistance and form an effective smoke stop. Where the lift motor room forms a separate compartment effective fire sealing should be provided round the drive between the motor and the driving shaft, and all other necessary openings between the motor room and lift-shaft should be kept as small as possible.

(4) Service and ventilation ducts

58. Service ducts serving more than one compartment should be of a fire-resisting construction having a grade of resistance at least equivalent to that of the structural elements bounding the compartments. Access doors to ducts within the building should be tightly fitting and should have a fire resistance equal to half of the duct. Insulation to pipes within ducts, unless non-combustible, should not be carried through the thickness of a compartment wall or floor. All holes or



COMPARTMENT X UP TO MAX. 20,000* SQ. FT. DIVIDED INTO TWO SUB-COMPARTMENTS X_1, X_2

COMPARTMENT Y UP TO MAX. 20,000* SQ. FT. DIVIDED INTO FOUR SUB-COMPARTMENTS (Y_1, Y_2, Y_3, Y_4)

*For Scotland read 15,000 sq. ft. to comply with Regulations

NOTE

FIRE-CHECK DOORS (B) TO STAIRCASES & STAIRCASE LOBBIES

FIRE-RESISTING DOOR (A) BETWEEN COMPARTMENTS (X & Y)

FIRE-CHECK DOORS (B) BETWEEN SUB-COMPARTMENTS (X_1 & X_2) (Y_1 & Y_2) (Y_1 & Y_3) (Y_2 & Y_3) (Y_2 & Y_4) (Y_3 & Y_4)

FIGURE 2. DIAGRAM TO ILLUSTRATE USE OF FIRE-RESISTING (TYPE A) AND FIRE-CHECK (TYPE B) DOORS (SEE PARAGRAPHS 50-56)

openings in walls and floors of the compartment through which pipes pass should be effectively sealed with a sealing material having a fire resistance equivalent to the surrounding structure. Where practicable the maximum size of non-combustible pipe that should be allowed to pass through a compartment floor or wall should be 6 inches; or combustible pipes, 1 inch.

59. Ventilation ducts serving more than one compartment should either be enclosed in a service duct or wholly encased in a fire-resistant construction having a grade of resistance equal to that of the structural elements bounding the compartment, with access doors having half that resistance (see paragraph 40 on fire shutters). These should be limited to the minimum necessary for effective cleaning and maintenance.

(5) Refuse chutes and chambers

60. The enclosing structure for refuse chutes and refuse chambers should be impervious and incombustible,

having a fire resistance of half-an-hour. Door to hoppers should have a fire resistance of half-an-hour and form an effective smoke stop. (See C.P. 306.)

(6) Transformer chambers

61. Any walls or floors separating a chamber from the remainder of the building, and any beams or stanchions situated within the chamber, should be of solid non-combustible construction and have a fire resistance of not less than 2 hours.

(7) Internal linings and finishes

62. The use of combustible materials for internal linings and finishings should be reduced to the minimum. Combustible materials may, however, be used for such items as windows, doors and internal trim. The standard test for classifying wall and ceiling linings is the spread of flame test of British Standard 476: Part 1, 1953. This test places the combustible linings in one of four classes:

Class 1. Surfaces of very low flame spread;
Class 2. Surfaces of low flame spread;
Class 3. Surfaces of medium flame spread;
Class 4. Surfaces of rapid flame spread.

The classification indicates to what extent it is easy for the surfaces to be ignited by a small source of flame and hence its susceptibility to chance ignition.*

63. Linings to staircase corridors and passages forming parts of an escape route should be non-combustible. In this context strict accordance with the non-combustibility test of B.S. 476 is not applicable. A material may be considered as presenting no greater hazard than a non-combustible for lining purposes in the following three circumstances:

(i) That the material is non-combustible as defined in B.S. 476: Part 1, 1953;
(ii) That the base material or background is non-combustible as defined in (i) above with the addition of a surface film not more than $\frac{1}{32}$ in. in thickness so that a spread of flame rating of the combined product is not inferior to Class 1;
(iii) That the material has a structural base or background of combustible material but is finished on any exposed face with a skin not less than $\frac{1}{8}$ in. in thickness of non-combustible material and the other face is not exposed to air.

64. In ward areas the walls should have the same standard as that recommended for escape routes, but ceilings of a Class 1 surface may be considered acceptable. In other areas of the building where the fire- and life-risk is low, and the area at risk is very small, Class 1 linings may be considered satisfactory.

(8) Suspended ceilings

65. At present it is not possible to give detailed recommendations on the design and construction of suspended ceilings. There are, however, several principles that should be observed when providing a suspended ceiling in a building.

66. Suspended ceilings are provided for a variety of reasons, for example to conceal services or for lighting, decorative or acoustical purposes. However, from a fire protection aspect, there are only two types:

1. Those that provide part of the fire resistance of the structural floor or its supporting members;
2. Those that provide no protection at all.

It should be noted that with either type the cubic capacity of the compartment should be calculated to extend to the structural slab and not to the suspended ceiling.

67. If the ceiling is part of the fire resistance the design must be such that the integrity is maintained under fire conditions. It is essential that the ceiling does not collapse due to expansion of the supporting members or that joints do not form weak links in the protecting membrane. Care has to be taken in the design of access panels to ensure that the membrane gives the full design protection. The space behind the ceiling is part of the compartment and dividing walls must be carried through to the underside of the structural slab; however, additional fire stops may have to be provided.

68. Suspended ceilings which do not contribute to the fire protection must not add to the fire hazard. The integrity of the ceiling should be maintained for as long as possible to prevent early collapse of the ceiling or ceiling panels. Preferably they should be non-combustible, but if combustible the exposed surface within the cavity should not have more flame spread than Class 1. In the design of suspended ceilings of this type, the aim should be to reduce the combustible content of the void to a minimum. Fire stops are required behind these ceilings (see paragraph 67).

B. Single-storey structures

69. The standards set out for multi-storey buildings should apply except that external walls may be constructed with combustible material.

*See Regulation 57 for Scotland.

V. Protection from external fire hazard

70. Fire may be carried from one building to another in a number of ways:

(i) Radiation, i.e. heat transfer without affecting the temperature of the space (the primary means of fire transfer);
(ii) Convection i.e. the flow of hot gases coming into direct contact with the exposed surface.
(iii) Flying brands.

A. Protection against fire in adjacent buildings

71. The measures which can be adopted to provide protection against the transfer of fire between buildings are:

(i) Adequate space separation;
(ii) Suitably fire-resistant construction of walls and roofs.
(iii) Fire-resistant protection of openings in walls or roofs.

72. Traditional brick external walls have a high standard of fire resistance and, where the percentage area of the openings to wall areas is comparatively low, the hazard of fire spread to adjacent buildings may not be excessive. Modern light-weight non-load bearing, weather-resisting sheathing has, however, in many cases replaced traditional types of external walls. In general, such forms of construction cannot be expected to have the same fire resistance. In modern buildings therefore, defence against fire hazard from adjacent buildings must be mainly by means of space separation.

73. Experiments have been carried out by the Joint Fire Research Station to measure radiation from burning buildings and to assess the range of intensity of radiation which may be found in practice. A report of this work is set out in the Fire Research Note No. 437 (1960). From the data in this Note it is possible to calculate space separation requirements for any size and shape of building and for any percentage of openings in an elevation. Guidance on the application of the method described in the above Note can be found in Fire and space separation by G. J. Langdon Thomas, in the Builder, November 11th, 1960, Pages 887-893 Vol. 199. The Ministry of Education's Building Bulletin No. 7, Fire and the Design of Schools (May 1961) provides a table of distances and types of construction on page 39.

B. Protection from fires spreading from storey to storey

74. Fire in a building can spread via its roof to other parts of the same building or to adjacent buildings if the resistance of the roof to fire penetration is low and if roof coverings have low resistance to ignition on their upper surfaces. B.S.476: Part 3: 1958, External Fire Exposure Roof Test enables the performance of particular constructions to be judged when subjected to specified exposure conditions. Roof constructions are graded into different categories depending on their performance in fire penetration and spread of flame tests. Building Regulations impose restrictions on roof constructions which have a resistance to penetration from external fire of less than half-an-hour, and on certain other classes of roof covering. Reference should be made to the appropriate regulations.

75. There is also the risk of fire spread outside a building from floor to floor via the windows. The present accepted separation of 3 ft. between windows in adjacent storeys, even if of a high standard of fire resistance, would be inadequate to prevent the entry of flame from a fire in a lower storey unless fire resisting glazing were used. To provide adequate protection it would be necessary virtually to preclude any windows at all in a storey immediately above one with openings in it. A horizontal projection of at least 3 ft. would be necessary to provide any substantial reduction in vertical fire spread. It is recommended that where high life-risk compartments are situated on the floor immediately and vertically above those of high fire-risk, the openings in such high fire-risk areas should be glazed with wire glass in metal frames and fixed shut. This whole subject is being investigated by the Joint Fire Research Station.

76. If control of the siting of buildings in relation to the site boundaries and to one another is applied, rigid requirements for the control of external walls becomes less critical. Where fire resistance is required to reduce thermal radiation, the walls need have fire resistance from the inside only for the period required for the structure as a whole.

VI. Fire brigade facilities

Access for public fire service appliances

77. Provision should be made for appliances to be brought to within 60 ft. of the main entrance of a building or of any dry rising main inlets. For this purpose a road, paved courtyard, or other consolidated area having a minimum width of 10 ft. and capable of supporting a pumping appliance weighing 10 tons should be provided. This approach should, as far as possible, be maintained permanently free from obstruction from parked cars by the provision of bollards etc., capable of being removed by the fire service. Fire appliances usually have a minimum turning circle of 27 ft. radius and a track 7 ft. 6 ins. wide; the approach roads should be designed accordingly.

78. Where forecourts or approaches are enclosed by walls or fences, there should be a clear opening at least 8 ft. 6 ins. wide and 11 ft. 6 ins. high. Access gates should be openable from either side.

79. Where all other recommendations of this Note are followed, paving or roads round a building for the approach of ladders are not considered necessary.*

*See Regulations 59 and 60 for Scotland.

External water supplies

80. The extent of most sites and buildings is such that there will usually be a need for private water mains and fire hydrants; only on the more compact sites, where all parts of the buildings are within 100 yards of a suitable public water supply, may this not be the case. Hydrant installations should conform to British Standard 750: 1964 and C.P. 402: 101 and be installed in consultation with the fire and water authorities.

Internal hydrants and rising mains

81. Internal hydrants fed by either dry or wet mains will rarely be necessary in buildings less than 60 ft.* high erected in accordance with this Note. Buildings with floors over 60 ft.* above the external ground level should be equipped with at least one rising main accessible to the fire service. Outlets should be so placed that all parts of the building are within 200 ft. measured along the line on which a hose would be laid. If this distance cannot be achieved with one rising main additional mains will be required. An air release valve should be provided at the top of each rising main. For further guidance see the forthcoming Technical Memorandum on Fire Precautions in Hospitals.

*Scottish Regulation 60, paragraph 1(a), requires mains in buildings over 35 ft. in height.

APPENDIX

Glossary of terms

1. Ground floor:	The storey in which there is situated an entrance to the building from the level of the adjoining ground or if there is more than one the lower or lowest of these.
2. Basement storey:	Any storey of the building which is below the level of the ground floor.
3. Height (measurement of)	The height of a building shall be taken to be the vertical measurement from the upper surface of the floor of the lowest storey to the underside of the ceiling of the topmost storey or, where there is no ceiling, to the highest part of the roof less one half of the vertical measurement between the lowest and highest parts of the roof.
4. Compartment:	A part of a building separated from the remainder by floors or walls which, together with all doors and shutters, have sufficient structural fire resistance to withstand the burnout of that compartment.
5. Sub-compartment:	A part of a building, usually a sub-division and of lesser extent than a compartment. It is separated from the remainder of the building by elements having sufficient structural fire resistance to contain a fire without prejudice to the use of an adjoining sub-compartment for a period of time. One of the purposes of a sub-compartment is to serve as a safe refuge for patients on the same level transferred to it from an adjoining area which is affected by an outbreak of fire.

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